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ABSTRACT

This paper discusses pitfalls in condominium design and the incorpoation of related noise control problems into classroom situations. Two case studies are provided, and a list of architectural noise problems found in many condominiums is included. (CP)

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CONDOMINIUM DESIGN: GOOD AND BAD NOISE CONTROL

by

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Introduction.

This paper discusses specific pitfalls in condominium design and its incorporation into the classroom. Our basic philosophy in the design and construction is stated. Several practical examples illustrate the message which we would like to convey.

The Course on Environmental Noise Control.

This past spring term we began what will be a series of courses in acoustics at Temple University. The object was to reach not only architectural and engineering students of Temple University, but practicing professionals from engineering firms and governmental noise control agencies working in the area. Judging by student enthusiasm and the way in which attendance held up during the night sessions from 7 to 10 P.M., we feel the course was a success. We are therefore planning an advanced course to follow the basic one. The first course will now be offered in the fall term, followed by the second course in the spring term.

A major factor contributing to the success of this course was undoubtedly the careful balance between theoretical acoustics and practical cases from the Philadelphia area. It gave the students a feeling of working with realistic and current problems. The course was highlighted by a series of seminars given by outside experts in the area

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of law, architecture, engineering and physiology. *

The students in the course had a wide range of industrial and academic background.** Our concern was to accommodate all of these students in the course without compromising our objectives. We overcame this obstacle as follows: Mathematics was presented where necessary, however its performance and manipulation was not stressed. Instead, we concentrated on the understanding of the fundamental engineering principles involved, at times, based perhaps on somewhat simplified models, and tested the students' ability to use practical aids in design problems. (These aids were in the form of various charts, nomographs, and other design techniques and were part of a generous hand-out package of some 100 pages). The first-hand and intimate knowledge of the case histories discussed in class, often provided numerous anecdotes which punctuated the lectures and added relief during the long evening.

The environmental noise course has two basic objectives. The first objective which is directed primarily to the undergraduate architecture and engineering students, is to introduce them to the principles of sound and its propagation, to the measuring instruments and techniques, and to the construction practice.

The second objective is directed to the practicing architect, engineer, and technologist and is to familiarize this professional group with the latest, up-to-date, developments in noise control, architectural acoustics and new materials.***

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** The architects, for example, had a weaker mathematical background than the engineers.

*** We concluded from this experience that an architect in order to keep up-to-date in acoustics, products, and practices needs an "up-dating" course, at least every other year. The architect does not seem to have an efficient method available to keep informed about the latest developments in acoustical techniques and particularly in new products, so vital in his field. For example, we find few architects and engineers who know the availability of operable sound-rated windows, acoustically treated venetian blinds, and many other products which recently were put on the market by manufacturers of conventional but non-acoustical products.

Flexibility in Condominium Design.

We also hope to teach some basic philosophy about such items as flexibility of design which does not limit the acoustical potential of the structure. For example,

(1) From an acoustical point of view, condominium spaces and even whole floors can be severly limited in their intended use if the equipment rooms and other utilities are improperly placed and misconstructed.

(2) The choice of an office plan may be serverely limited if the installation of suspended ceilings with lighting fixtures and their reflecting lenses are already in place. A procedure which is potentially less costlier is to delay the choice of ceiling and the choice of lighting fixtures until the general office plan concept has been set by the client or purchaser.

(3) HVAC* feeds and returns which are not ducted, usually place a severe acoustical limit on a given space, as will be seen later in this paper. Ducting for both feeds and returns is preferred.

(4) The potential use of areas may be complicated further by deciding on the type and location of doors and windows before the client submits his intended use of the space. Doors and windows may acoustically limit an area to its intended use.

The Open Plan Office.

The open plan office, seen often in office condominiums, is a popular subject. It should be mentioned here because it is discussed a great deal by interior decorators and architects. They usually do not study the underlying acoustical fundamentals. Hence, we find buildings with built-in limitations which will make it impossible for the occupants to ever realize a satisfactory plan. For example an inexpensive ceiling may be selected in the belief that it will be economical.

* Heating-Ventilation-Air Conditioning

However, we will find that this results in-a much poorer space utilization because people must be placed farther apart in order to realize adequate interzone attenuation in the open plan. It does not make sense to select a ceiling system by chance or by the salesman's catalogue. The same is true of lighting fixtures and their placement, as we have suggested above. A few misplaced lighting fixtures with reflecting lenses can completely destroy the interzone attenuation, particularly if they are placed over a sound screen.

Other speakers on this program are covering the subject of open office planning and we wish to re-emphasize it so as not to ignore the important work of Geiger and Hamme and others who have thoroughly analyzed open office planning. The detailed methods have been set forth in readily available government publications and can be taught to students of architecture. At least they should have some exposure to such material to know what can and should be done.

An architect might not be prepared to carry out the verification of speech privacy potential based on objective measurements as presented in the U.S. Public Building Publication Service* (PBS-C.2), but he should be aware of its existence and the fact that an acoustical consultant can do so. At least an acoustical consultant can advise him and his client on the proper layout of an open office and be sure that proper treatment is given to ceiling, walls, windows, floors, sound screen barriers, mashing sound, etc. Many builders of modular office equipment do not seem to be paying attention to this subject which is so closely at the heart of their own business. We hope this situation is also corrected by further education.

* General Services Administration, Washington, DC.

Pitfalls in Condominium Design an Architect Can Avoid.

Expensive mistakes which we have noted in condominium design and construction may be avoided by realizing what they are. The principle failures we encountered are listed below:

(1) Failure to account for noise propagation within the building structure resulting in a poor lay out of facilities and space utilization.

(2) Failure to evaluate the sound sources within the building. Fortunately, most equipment manufacturers have now undertaken elaborate preparations to present adequate sound data on their particular products. This information is readily available and the acoustical consultant knows how to use it.

(3) Failure to establish Noise Criteria (NC) for spaces in terms of their intended use. Close cooperation and consultation with the client is essential. Only he knows exactly the activities and locations of his people. This is even more important for open office planning where the architect should know exactly where the secretaries will sit as distinct from say engineers and attorneys who require much more speech privacy.

(4) Failure for not having acquired a working knowledge of noise control structures and details such as floors, walls, ceiling plenum etc. Much information has been made available on these subjects by the manufacturer of building products and their trade associations. It is too wasteful not to use this valuable information before the structure is assembled.

(5) Failure to submit their drawings to an acoustical engineer or consultant for even a brief check. It is interesting to note that an architect wouldn't think of bypassing the HVAC or structural consultant, yet he leaves the acoustical matter to chance. The resulting complaints, legal action and frustration are the cause of an expensive and unpleasant disaster for everyone but the lawyers.

(In our examples we will show some of the expensive rework methods that have been necessary to fix the problem which could have been prevented in the first place).

(6) Failure to follow up on trade installers. This is unfortunate because the acoustical consultant can briefly check in at the job once a day if necessary and immediately determine whether things are being assembled properly from a noise control and acoustical standpoint.

(7) Failure to appreciate the diverse attitudes and motives of the owner, the architect, the builder and the occupant. We will not list just what these attitudes and motives are, but we think you can guess either optimistically or cynically. The architect needs to be aware of all these; he needs to act as mediator, ambassador, educator, and preacher of the noise control gospel.

Examples: Two New Large Condominiums.

As examples we have chosen two large new condominiums, one residential and one a business or office condominium. Condominiums along the seashore are rapidly replacing the old hotels as reosrt homes (for those who can afford them). This is partly because of the poor economic returns of hotel operations. Labor costs have risen so that hotel operation in the old sense is economically no longer feasible. The condominium on the other hand requires very little service help and the occupants, if reasonably satisfied, more or less run things themselves. We are not quite sure what the motivation for occupancy of an office condominium might be from the purchaser's standpoint, but from the owner's or builder's point of view there is probably more stability and less transient moving about in comparison to rented property.

A Residential Condominium

Let us first discuss an ultramodern, beachfront, high-rise, residential condominium. You will see that from Slide 1 a new building, the larger one, was built very close to a former occupant of the area. The fact that the new condominium was larger and obstructed the view from the whole side of the adjacent

condominium which arrived there a few years earlier. Of course that arrangement did not please the older condominium and its residents. Legal procedures followed, but ot no avail. The new, tall condominium however was subject to an unexpected pitfall, namely the cooling tower on top of the older lower building (Slide 2). Those familiar with cooling towers will recognize this as one of the older more noisy types, as was brought home forcefully to all the residents on that side of the new building. Since the balcony living is a way of life and the large sliding glass doors completely exposed the living quarters to the raucous sounds of this noisy cooling tower, you can well imagine what ensued. Lawyers appeared from both sides, and there followed several years of conflict. (At this point we should mention another important aspect of our philosophy which we constantly stress in our classroom and that is "keep the lawyers out of it". In most cases the legal fees amount to more than the cost of fixing the acoustical problem; including consulting, labor and materials).

The next several slides show the proximity of the buildings and further illustrate the rather obvious nature of the problem (Slides 3 and 4). The new building had a more modern and better housed cooling tower equipment on top, (Slide 5), but the people in the older building which caused the noise problem were naturally not interested in the discomfort of the "newcomers". In fact they were rather gleeful about the discomfort they were causing those who had shut off their view of the beach and the ocean.

This expensive lesson points out the importance of considering all aspects of new building sites, and especially roof top noise generators. It shows also one of the undesirable effects of crowding buildings so closely together, particularly in a lovely setting such as the ocean front.

Looking further inside this first-rate condominium we find it has its own problems because nobody followed-up the work of the trade installers...The next slide (Slide 6) shows the pump room where the booster pumps were installed on a

concrete slab which was intended to have been spring supported. The slab was installed but was poured in place on the floor without a spring support. Hence all pump vibrations, which wer substantial for this type of machinery, were transmitted to at least two floors... a number of expensive dwelling spaces were rendered nearly uninhabitable.

Other items of plumbing such as the flexible coupling in the next slide (Slide 7) were shown to be completely short circuited by large bolts which the installer did not realize were to be loose and used as expansion limits only. The isolator type pipe hangers (Slide 8) were intended to have double rubber attachments, while in fact the installer bolted them tightly against the concrete slab so that they were essentially useless for high frequency isolation. We reiterate that following up the trades is important and cannot be overdone. The last two problems are not too difficult to correct, while the re-installation of the pumps on a spring-suspended inertia block constitutes a major difficulty and expense.

An Office Condominium.

The next example will be an office condominium in Philadelphia (Slide 9) where a number of conceptual and installation errors were not caught in time.

The conceptual error was placing individual equipment rooms in the center of each floor and not providing sufficient space for ductwork to be aerodynamically routed (Slides 10 and 11). Consequently the HVAC units dumped their air into a single plenum casing with great turbulence, and this was piped away without regard to gradual bends or properly designed ducting. The return was much worse. The ceiling plenum was used as a return with no acoustic attenuation whatsoever. Some floors returned air directly through louvers between the equipment room and the office area.

Under these conditions the ductwork rattled and vibrated. As you will see in the next slide (Slide 12) the dry wall assemblers put the icing on the cake by fastening the metal studs directly to the ductwork. Of course this transmitted the duct noises to all walls so that building was vibrating in every aspect. We

were called in at about this point after one floor had been sold and occupied by a very discontented client who expected extremely high class quarters.

By this time new buyers of space were being sought. However, when word got to them about the poor acoustical performance of the first floor that was occupied, they were unwilling to proceed with their purchase of other floors. Hence guarantees had to be given by the owner to remedy the noise problem. You can well imagine how unconvincing this was to they buyer. Much of the ceiling structure had to be disassembled (Slide 13) and a great deal of urethane foam and lead were required in an attempt to create an acoustically adequate air return plenum which would not radiate into the office spaces.

We learned about this time that the designers of this building had been scheduled to design another building for the owner, but he was now so disgusted and it looked as though the designers would lose that job. Clearly the repercussions of a few foolish acoustical mistakes can propagate in all directions and lead to a great deal of unhappiness.

Conclusion.

Education is clearly the answer, along with diligent follow-up and an appreciation of the acoustical problems in general. These few examples demonstrate what we are attempting to do, in particular, for the architectural students who are our next generation of architects. Hopefully they will return for periodic updating along with other practicing professionals.